



Resource Ramblings

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Wind Cave National Park Resource Management News Briefs

This Issue Edited by Rodney D. Horrocks, Physical Science Specialist



Caption: The cave lighting maintenance crew from Wind Cave doing cave restoration work on the new Blue Grotto Tour Route. Pictured from L-R are: Brandon Reary, Clayton Ford, & Jeff Symstad. NPS photo by Jason Walz.

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A Little Moonwort Madness in Wind Cave National Park?

By Beth Burkhardt
WICA Botanist

Wind Cave NP is an extraordinary landscape of prairie and ponderosa pine forest. Aspects of the vegetation that make it worthy of note include:

- 1) 17 plant species tracked by the South Dakota Natural Heritage Program, ranked from critically imperiled to vulnerable at the state level;
- 2) 58 plant species of very limited occurrence tracked by Wind Cave NP; and
- 3) 9 rare native plant communities, ranked from imperiled to vulnerable at the global level.

Two of the species tracked by the SD Natural Heritage Program found in Wind Cave NP are known affectionately by those familiar with them as “green goblins”, partly in reference to their small, green appearance and partly because it is so hard to find them! They are members of the adder’s tongue family (Ophioglossaceae), also referred to as moonworts. The species currently known from Wind Cave NP are *Botrychium campestre* (prairie moonwort, left photo) and *Botrychium lineare* (slender moonwort, right photo).



Botrychium campestre (prairie moonwort, left photo) and *Botrychium lineare* (slender moonwort, right photo). NPS photo.

Prairie moonwort is ranked at the state level as between imperiled and vulnerable (S2S3) and slender moonwort is ranked at the state level as critically imperiled (S1). [Note: A species is

ranked as critically imperiled because of extreme rarity (for example, fewer than 5 known occurrences) or because of some factor making it vulnerable to extinction. Species ranked as imperiled and vulnerable are more numerous but still of concern with regard to their long-term persistence.]



Botrychium simplex (little grapefern) with hairless roots. Black Hills Botrychium Workshop 2006. Photograph by Katherine Zacharkevics.

The hazard of getting interested in moonworts is that you might come down with a case of moonwort madness – the insatiable desire to crawl around on the ground for the thrill of spotting a moonwort! Moonworts are a challenge to find. First of all, they are very small, with a maximum height of 4-5 inches. Secondly, they don’t come up every year. One of the fascinating things about *Botrychium* species is that they have an obligate association with soil fungi (mycorrhizal fungi). Moonworts rely on mycorrhizal fungi in both their life stages. They reproduce by spores which can germinate without mycorrhizal fungi but cannot mature without them. The gametophyte phase of a moonwort may live underground up to 5 years using carbohydrates and minerals gained from the mycorrhizal interaction (Anderson 2003). Sunlight needed for typical plant photosynthesis is not an issue for moonworts at all during this time! Moonworts in their green (sporophyte) phase which appears aboveground also depend on mycorrhizal fungi – moonwort roots do not have root hairs like “normal” plant roots and cannot absorb water, nutrients, and minerals without

mycorrhizal fungi. As interesting and important to the moonworts as this interaction with mycorrhizal fungi is, not very much is known about how it works.

Moonworts are found by crawling on the ground and looking carefully among the residual vegetation. As you can imagine, this means that moonwort survey is not quick! Because the search is so time intensive, it is very helpful to have an idea of suitable habitat in order to focus search efforts where the chances of success are greatest. The master of identifying moonworts and moonwort habitats is Dr. Don Farrar, retired professor from Iowa State University and internationally-recognized *Botrychium* expert. [Note: because of a lack of physical characters, final *Botrychium* species identification is based on genetic analysis.] Dr. Farrar has been leading local botanists in moonwort surveys in the Black Hills (funded by Black Hills National Forest) since 2001. The result speaks for itself: in 2000, 2 *Botrychium* species were known from roughly 4 locations in the Black Hills. By 2008, 11 *Botrychium* species (and 3 hybrids) from 132 locations had been documented. One piece of that story was discovery of an occurrence including both *Botrychium campestre* (prairie moonwort) and *B. lineare* (slender moonwort) by Dr. Farrar on Gobbler Ridge in Wind Cave NP in 2005 (Farrar et al. 2006). This was the first rediscovery of prairie moonwort in the Black Hills since a voucher collection by Dr. Robert Dorn from the Bearlodge in 1973 and the first mixed population of prairie and slender moonwort documented in native habitat in the U.S. (Farrar personal communication 2009). In addition, the Gobbler Ridge occurrence is a large one (individuals/sporophores numbering about 1,000). Information provided to US Fish and Wildlife Service about this occurrence was one factor contributing to the removal of *Botrychium lineare* (slender moonwort) from their Candidate species list in 2007.

In 2006, botanist Faye Streier (working for Wind Cave NP) discovered some additional moonworts within a half-mile of the known Gobbler Ridge occurrence that were confirmed by Dr. Farrar as

Botrychium campestre (prairie moonwort). A second location of prairie moonwort in the Red Valley (eastern part of the park) consisting of 3 plants was discovered by Dr. Farrar in 2005 but no collections were made (therefore, species identification not confirmed). The area was searched every spring from 2006 through 2008 with no success at relocation. A single moonwort in the Red Valley occurrence area was located in 2009 by Beth Burkhart but no collection was made for species identification because only one plant was found (after considerable search) and the spores had not yet been released. The identification of the Red Valley moonworts remains a mystery!



Dr. Don Farrar at Wind Cave NP Gobbler Ridge moonwort occurrence in 2000. NPS photo.

As you can tell, the full story of moonworts in Wind Cave NP is still unknown. Is the Gobbler Ridge occurrence the only large moonwort occurrence in the park? It doesn't seem that it should be since Gobbler Ridge doesn't appear to support unique habitat relative to the rest of the park. However, with only limited search completed, we haven't yet found any other large moonwort occurrences. If it is the only large occurrence in the park, what conditions are different on Gobbler Ridge than other north-facing slopes with high native plant biodiversity - use by grazing animals? fire history/pattern? soil details? geologic substrate? If the Gobbler Ridge occurrence turns out after more survey to be unique in Wind Cave NP, then we will need to examine more closely what management choices are most supportive in conserving its high quality persistence.

Another question to be answered is whether *Botrychium campestre* (prairie moonwort) and *Botrychium lineare* (slender moonwort) are really the only moonwort species in the park. There are several other moonwort species that have been found in foothills grasslands around the Black Hills in the last decade that would seem to be a match for habitat in Wind Cave NP. In addition, there are still possibilities for discovery of *Botrychium* species new to science, an example being *Botrychium* 'redbank' (formal description and naming by Dr. Farrar in process) discovered by Dr. Farrar near Redbank Springs in the central Black Hills in 2005 (Farrar et al. 2007).



Wind Cave NP vista – are there moonworts out there?
NPS photo by Beth Burkhart.

All it takes to continue unfolding the moonwort story in Wind Cave NP is time and effort! Another confounding aspect of moonworts at elevations such as those found in Wind Cave NP is that the aboveground sporophores (if they come up at all in any given year) are only visible for several weeks to a month early in the growing season (April – May). After the spores have been released, the small plants shrivel up and disappear, leaving no visible trace of their presence. This makes the window for moonwort survey quite short compared to that of other vascular plant species.

Botrychium (moonwort) surveys will be scheduled in Wind Cave NP this spring – for several week days in late April and early May. Contact Beth Burkhart, WICA Botanist (745-1149 or Beth_Burkhart@nps.gov), if you would be

interested in participating in moonwort surveys in the park this year. No experience necessary! We will develop everyone's search image by monitoring/observing plants in the known Gobbler Ridge occurrence before heading into unsurveyed territory in the park. Everything we do will add to the information base of the park relative to these "green goblins" and perhaps result in a few people coming down with a case of moonwort madness!



Typical *Botrychium* survey group (Black Hills NF 2009 survey in Schenk Canyon). NPS photo by Beth Burkhart.

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Restoring the New Blue Grotto Tour Route

By Jason Walz

WICA Physical Science Technician

Every summer, about 1,400 visitors, out of a total of 100,000 people that go on Wind Cave tours, actually go the Candlelight Tour Route. Part of this tour is an adventurous walking tour over natural terrain, with only a candle bucket for light. However, the first half of the tour is now a paved loop that we have decided to call the Blue Grotto Tour Route. This tour contains the only blue-colored boxwork that can be seen on any of the cave tours. For many years, the loop followed a dry dirt path and every time a tour passed, the group sent dust billowing up to 30' from the trail. In 2008, the park decided to reverse the process by creating a new paved tour route. In the process we would change one of the dustiest tour routes into one of the cleanest areas, spotlighting the blue boxwork. To accomplish this goal, the park started by concreting the path and beginning a long-term cave restoration project to remove the accumulated dust.



Rod Horrocks works on a cave restoration project with National Honor Society volunteers from Hot Springs High School in the St. Dominic Chamber in the new Blue Grotto Tour Route. Photo by Jason Walz.

The cave restoration process starts with brushing, where employees and volunteers use nylon bristle paintbrushes to gently “sweep” the passageways. The goal of brushing is to lightly abrade the cave surface without damaging delicate areas and to remove the bulk of the non-natural material, (such

as lint, dust, and hair) from the cave. Following the brushing, the area is vacuumed with a HEPA vacuum cleaner. As the vacuum nozzle brushes across the walls, the brown color lifts off.

The final step in the process is to rinse the cave walls and ceilings with water. Clean dechlorinated water is brought into the cave and the dirty water is collected using tarps and buckets and carried back out of the cave. This process has a dramatic visual effect, revealing the natural colors of the cave.

Currently, the restoration project has passed the half-way mark. Since January, more than 600 working hours have been dedicated to cleaning this tour area by WICA employees and volunteers. The bulk of the work has been done by the Cave Lighting Crew (see cover photo). While waiting for backordered lighting supplies, Maintenance Division employees put in more than 450 hours of work and carried out almost 5,000 lbs of debris. The project is also incorporating volunteer groups like the National Honor Society from Hot Springs High School that donated over 30 hours during a recent weekend (see accompanying photo). Dedication from employees and volunteers have made this project a success, and will hopefully finish the restoration of the new Blue Grotto Tour Route.

No Bison Roundup Planned for 2010 & Status of the Wind Cave National Park Bison Herd

By Barbara Muenchau

WICA Wildlife Technician

The Wind Cave National Park (WICA) bison herd continues to be highly sought after by conservation groups trying to re-establish wild bison herds due to their high level of genetic diversity, lack of cattle gene introgression and brucellosis free status.

The current WICA bison population of 300-325 is the lowest it has been in 10 years. This may reflect natural reductions in a herd subjected to over 5 years of drought and the stressors that go along

with it, i.e. less available forage and water. The park was also experiencing at the same time, an elk population upswing, due to limited management options with current winter populations of around 900 animals (the management goal is 232 to 475).

In an attempt to maintain genetic diversity and to adjust the sex ratio to a more even sex ratio of 50/50 or 60/40 (fem/male), which in turn will allow for additional calf recruitment, it is the recommendation of the resource staff that the number of cows be increased to allow for additional calf recruitment, while striving to increase the total adult bison population (post roundups) to approximately 350-500 animals.

Since there are limitations on the amount of forage available for our grazers in the Park, it is also recommended that the elk numbers be reduced to the lower end of the population range (<300 animals) decided upon in the recently approved Elk Management Plan/EIS. We realize the reduction of the elk herd and the increase of our bison herd will take time but we feel this is an important goal to be striving for over the next 1-4 years.

It is hoped that the Park can accomplish this goal while still providing some surplus bison to the conservation groups who are depending on Park bison to develop their herds.



*A bison and her calf in Wind Cave National Park.
Photo by Barbara Muenchau.*

2010 Recommendations

The Park currently has an estimated 73 calves (38M, 35F) from 2009 and it is recommended that WICA not consider any of these as surplus animals in 2010. This will allow for a large increase in breeding aged heifers in 2010 or 2011 and should increase the numbers of calves produced in future years. Potential partners have been notified of the decision, and the initial response has been supportive.

Subsequent needs for roundups and the numbers of surplus animals that can be culled will be evaluated on an annual basis and will strongly consider the need to rebuild the WICA bison numbers back up to the 350-500 adult animals and desired sex-ratios for post-roundup levels. The coordination of this increase in conjunction with a determined effort to reduce elk numbers will help to protect the important plant communities which 'fuel' the ecosystem. Continued research on methods to lower costs, reduce safety issues, and better facilitate rounding up bison will also be investigated and conducted.

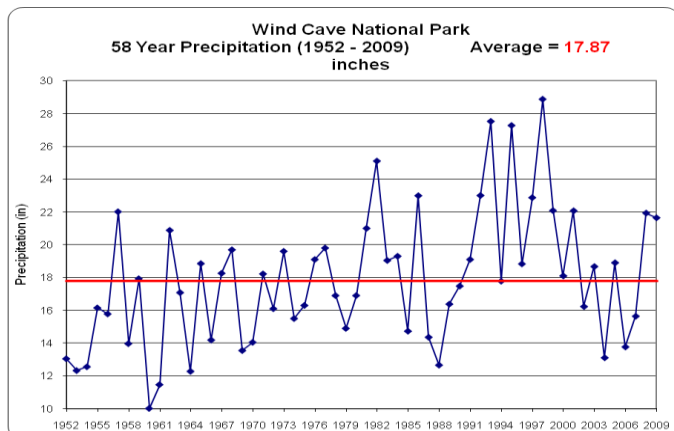
WICA will also need to continue to refine the prioritization process used for determining which conservation organizations, tribes and agencies the surplus bison should be provided to. Development of satellite herds that include only WICA bison are currently felt to be very important as a genetic pool reserve in case disease or an environmental catastrophe should impact the WICA bison population in South Dakota.

Wind Cave National Park 2009 Precipitation

By Barbara Muenchau
WICA Wildlife Technician

Wind Cave National Park staff members have been collecting precipitation data since rain gauges were first installed in the park in 1940. Precipitation was documented on a monthly basis from 1940 to 1946, then only sporadically from 1947 to August, 1951. Since then, continuous monthly precipitation data has been recorded, giving us fifty-eight years of information.

As is typical in the Great Plains, Wind Cave annual precipitation can fluctuate greatly. In the last 58 years, precipitation has ranged from a low of 10.02” in 1960, to a high of 28.87” in 1998. The Park’s 58 year **annual average is 17.87 inches**. The Park received **22.20 inches** of precipitation in the **2009** calendar year.



1952-2009 annual precipitation (58 year average = 17.87).

This precipitation data, along with the daily high/low temperature and snowfall measurements, is the official Wind Cave weather submitted to the National Weather Service. The Park also has extensive monthly temperature data. Resource Management staff is in the process of compiling this data.

Surprise Daytime Sightings of Black-Fotted Ferrets

By Barbara Muenchau
WICA Wildlife Technician

A completely unexpected observation was made on March 17, 2010 at 3:30 in the afternoon. A black-footed ferret was observed in the Norbeck prairie dog colony, being chased by three prairie dogs!

The ferret was observed for ~ 40 minutes, and then a reader was placed at the burrow entrance to see if we could identify it.

The reader was left in place for 9 hours, but no identification number was obtained – which could

mean either the ferret had no pit tag, or it didn’t leave the burrow during those 9 hours. So...keep your eyes peeled - you never know what you might see out in the Park!



A black-footed ferret checking to see if the coast is clear in the Norbeck prairie dog town. NPS photo by Barbara Muenchau.



The same black-footed ferret being chased by three prairie dogs in the Norbeck prairie dog colony. NPS photo by Barbara Muenchau.

Keeping Track of Grouse Populations in the Park

By Dan Roddy
WICA Biologist

Sharp-tailed Grouse lek (dancing ground) surveys are conducted in April to obtain counts of birds using the leks. This information is used in the development of population trend data for Sharp-tailed Grouse within the park.

The peak of attendance by females on the leks is generally April 8 – 22nd in South Dakota although due to weather conditions, earlier or later in April may be just as productive. This timeframe normally yields the highest number of birds with both males and females spending time on the leks. Once the females are mated, they no longer have a need to visit the leks, while the male grouse continue dancing into May for additional females that may have not been mated during the peak time period.

Date	Max # Birds	Southern end of Park	Eastern half of Park	Comments
1999	91	37	54	Active leks (3 southern / 4 or 5 eastern)
2004	56	19	37	Active leks (2 southern / 4 eastern)
2007	57	08	49	Active leks (1 southern / 4 eastern)
2008	16-18	00	16-18	Active leks (0 southern / 2 eastern)
2009	17	00	17	Active leks (0 southern / 3 eastern)

Five years of grouse lek survey data demonstrating the decline in the number of grouse making use of the leks.

2009 Survey Results:

Eastern Half of Park – the maximum number of Sharp-tailed Grouse using the leks on any one morning was 17. Surveys were conducted on April 8th, April 14th and April 24th. The highest number of grouse (17 birds) was observed on April 14th.

Four of the 9 leks on the eastern half of the park had birds using them or there were birds observed in the vicinity of the leks.

Southern End of Park – grouse have not been recorded on any of the 4 leks on the southern end of the park since 2007. Eight grouse were observed on 1 of the leks that year. Since 2007, informal searches for birds using the leks have been carried out but little evidence has been found. Other than a few droppings and an occasional sighting of a grouse on the southern end of the park, there has been little activity observed on the leks during the breeding season. For comparison purposes: Over the past 10 years, there have been 5 concerted efforts to survey all of the known grouse leks in the park during the months of March/April/May. As was the case in 2009, the data from previous years is incomplete or unreliable as far as breaking down the number of females and male birds on the leks. The numbers in the chart only reflect the total number of Sharp-tailed Grouse on the leks. Even with the less than optimal data, it is still apparent that the number of Sharp-tailed Grouse has declined over the past decade. A more thorough, timely series of lek counts are planned for April 2010.



Sharp-tailed Grouse – male displaying for females on lek #2. Photo by Kerry Buck.

Discharge Measurements of Beaver Creek Spring

By Marc Ohms

WICA Physical Science Technician

Beaver Creek Spring is located in the Beaver Creek drainage south of Wind Cave National Park on private property. The landowners have graciously allowed the park to conduct water sampling and discharge measurements. The spring is a large reassurance of groundwater that forms a stream that continues down to the Cheyenne River. Many ranchers depend on water from the stream for irrigation and cattle watering, and the Trout Haven Ranch depends on the water to raise trout.

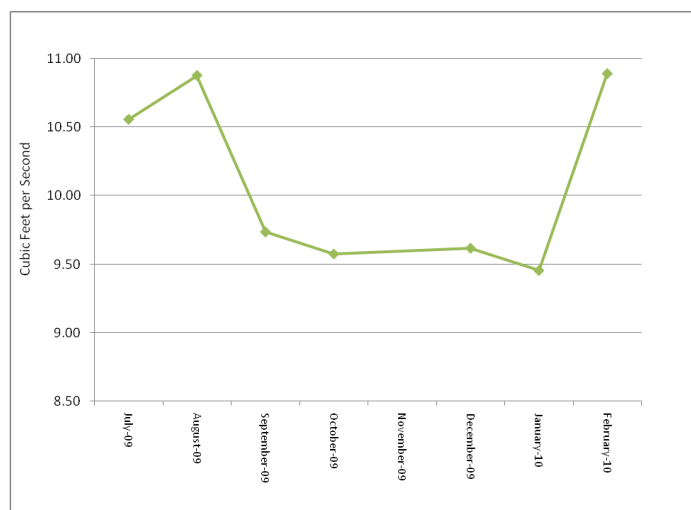
Measurements are made by use of a pygmy flow meter and conducted by the protocols established by the United States Geological Survey (USGS) (*Rantz and others, 1982*). This requires wading in the stream and taking measurements at set intervals across the width of the stream. The stream is 20-feet wide at the measurement station and readings are taken every 8 inches across that width. Discharge measurements are made monthly, even during the winter. Since the water in the spring emerges at 67 degrees Fahrenheit, the stream never freezes.



Marc Ohms obtaining discharge measurements from the creek below Beaver Creek Springs in the Buffalo Gap area. NPS photo by Marc Ohms.

Recently a proposal was made to create a rural water system using water from the Madison

Aquifer. A total of five, 10-inch diameter wells will be drilled to supply the system, with at least one well located within 1 mile of the southern park boundary. How this will affect the cave lakes, the park's wells, Beaver Creek Spring, and neighboring landowner's wells is uncertain. However, the results of the model calculations indicate that groundwater development at the proposed pumping rates has the potential to cause significant declines in groundwater levels in the park within just one year of continuous pumping. Drawdown within the area of the cave and the park's well could reach over 70 ft within 10 years if all proposed pumping is centered on the wells located closest to the park (*Cuttillo 2006*). This would greatly affect the parks well and for the first time in geological history, the groundwater lakes within Wind Cave could vanish.



Discharge of Beaver Creek Spring.

Obtaining monthly discharge measurements at the spring is part of a larger effort to obtain a better understanding of the Madison Aquifer, and what affects we could see due to large extractions of groundwater. In addition to Beaver Creek Spring, the lakes in Wind Cave, the park's wells, over two dozen private wells, cave drip sites, Elk Mountain Spring, Beaver and Highland Creeks, and precipitation are all being monitored. The water's physical parameters, chemistry, age, and level or flow are all being documented and analyzed (*Long and Ohms 2008*). The overall goal is to gain a better understanding of how water moves through the system. Obtaining as much data as possible

prior to the production wells is vital to understanding the changes or influences the increased withdrawals have on the aquifer. With this knowledge the park, other land agencies, and private landowners can better understand and therefore protect and manage their water resources.

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Long, Andrew, and Marc Ohms. 2008. TRACE KARST GROUNDWATER FLOW TO ASSESS WATER QUALITY IMPACTS IN WIND CAVE NATIONAL PARK. NPS/USGS Water Quality Partnership proposal for funding.

Rantz, S.E., and others. 1982. MEASUREMENT AND COMPUTATION OF STREAMFLOW Volume 1 and Volume 2. Geological Survey Water-supply Paper 2175, 686p.

spermatophores in the water and if the female is responsive she will in turn swim over top of the spermatophore and insert it into her cloaca. The annual ritual (unless the rains do not arrive) is much more involved than this but the author will spare you the details unless of course you are interested. If so, stop by the office and we can continue the Sex Education 101 discussion (but only for tiger salamanders).



10" long Tiger salamander on its way to the temporary pond on Bison Flats. NPS photo by Barbara Muenchau.

Tigers on the Move

By Dan Roddy

WICA Biologist

A 10" long Tiger salamander (*Ambystoma tigrinum melanostictum*) was found near the temporary pond on Bison Flats at approximately 9:00 PM on March 17, 2010. Judging by the swollen cloaca (area just behind the back legs), it appeared to be a male salamander getting an early start on things. Often-times males arrive prior to the females at the breeding ponds. The main breeding activity appears to be positively correlated with rainfall in the spring. It appears that most breeding activity occurs from mid-March through April but probably is adjusted accordingly depending on if and when the spring rains arrive.

SEX EDUCATION 101:

The swelling, just behind the back legs of a male, is where they carry their spermatophores (capsule containing sperm). The males deposit the